TREMBLEY (J. B.)

Meteorology

OF

OAKLAND, CALIFORNIA,

FOR 1882-3 AND 1883-4.

BY J. B. TREMBLEY, M. D.

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REPORTS AND STATISTICS

OF THE

METEOROLOGY

OF THE

CITY OF OAKLAND, CALIFORNIA,

FOR THE YEARS 1882-'83.

OBSERVATIONS TAKEN AT 7 A. M., 2 P. M. AND 9 P. M. OF EACH DAY,

By J. B. TREMBLEY, M. D.

Latitude 37°, 48', 20'' North; Longitude 122°, 15', 20'' West; Height of Barometer above the Sea, 24 feet.

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OAKLAND, CAL.:
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1884.

CALIFORNIA.

California is but little known in all that is peculiar to her climate, health and productiveness. Even those who were here and wandered over her vast valleys, her hills and mountain ranges long before the advent of the present occupants, were unacquainted with her real resources and productive capacity, as well as the more recent pioneer, who first sought her El Dorado, in search of gold. Notwithstanding nearly every nook and corner of her great area has been searched for the precious metals, her mountains for various woods, her valleys for soil capable of agricultural purposes; still, but very few, if any, have a correct idea of her vast wealth yet undeveloped, in mining, in agriculture, in horticulture, in manufactures and commercial intercourse.

All as yet are in its infancy, as it regards her present people and the developments they have made; what this period of her history will accomplish with her present civilization is yet to be seen.

She has no history of the past, like the countries of the Old World, which has grown by centuries, and can trace their progressive civilization back through times remote, but came into life and the knowledge of the world at a bound, at a moment of time, flushed in the full power of nationality.

The history of her early races are found only in the few remains of stone implements for domestic use, and for that of the chase.

These natives seemed to have been connected some way with the early geologic times, when the ocean laved the base of the Sierras and the great interior valleys were bays of water. They were low in the scale of mental development, lived an animal life, incapable of progress, or making any kind of civilization, leaving neither a history or tradition of themselves. As found by the early Fathers or Franciscan Friars, who journeyed up the coast about the middle of the seventeenth century, they were an artless, wild, but simple people; they soon learned to do the bidding of these missionaries, and became converts to the religious teachings which

they taught. Missions were established here and there along the whole coast line of the State, religious instructions were brought to bear upon these confiding, ignorant aborigines, they were gathered around the missions and became the neophytes of the church. The missions soon grew rich in horses, cattle, sheep and grain, and the poor savages, who had perhaps bettered their condition in life some ways, began a life which doomed themselves and their posterity, to decay, destruction and death.

This historical epoch of the early fathers, or parochial government of the missions, existed from 1769 to 1822, fifty-three years, during which time much had been accomplished in pastoral life, to bring the country from an historical myth to a reality.

Then came what might be called the third era, or epoch, in the history of California, when Mexico threw off her allegiance to Spain, and established a civil government at Monterey in April, 1822. This third period lasted from 1822 to 1846, when the territory which now embraces the area of California, came into possession of the United States and the stars and stripes were hoisted at the, then, Mexican capital Monterey. Here begins the fourth epoch in the history of California and contiguous territories belonging to the western slope of the Rocky Mountains, and dates the beginning of a new State, which in many respects has been the wonder of the world.

The Mexican or Spanish Californians, who then were the occupants and possessors of the soil, were awakened from their Arcadian life, by the vast army of peaceful, unorganized invaders, who were ready at all times and places to improve their conditions of life, and make the most of all things, that surrounded them. This moving host—these argonauts of 1849, who reached California in search of gold, were young, robust, energetic men, from the States mostly east of the Mississippi River, men of courage, vigor, education and enthusiasm. Men whom nothing would daunt, that would overcome all obstacles, who knew not the word fail; with such a population thrown into a virgin country, rich in all resources, and climate unsurpassed, much might be expected, and much they have done.

Says John S. Hittell, one of the pioneers of '49, a terse and prophetic writer of 1863: "Much we have seen; more we shall see. Our State is the Italy of the new world, possessing a dower of beauty not inferior to that of the Latin Peninsular; but unlike that, not destined to be fatal in its attraction. We shall gain victories

and celebrate triumphs more numerous and more glorious than those of Republican and Imperial Rome; but our triumphs will be those of good will—the triumphs of the architect, the road builders, the engineer, the inventor, the farmer, the miner, the scientist, the author, the printer, the musician, the orator.

The highest civilization will make one of its chief centers here. The great valleys and table lands between the Sierra and the ocean, on account of the mildness and equability of their climate, will be the favorite place of residence for many thousands from abroad. They will fill the lands with wealth, luxury and art. California will occupy in the hemisphere of the Pacific, as a focus of intellectual culture, a position similar to that long held by Attica in the basin of the Mediterranean. Looking confidently forward to such a result, hoping to see much of it accomplished in our own time, let us endeavor to lay a broad, solid and generous foundation for the political, industrial and educational greatness of our State; let us be proud that we have taken part in a work which has contributed much, and will contribute more, to stimulate commerce and to extend civilization, and as a consequence, to enrich and benefit mankind, a work which will be forever prominent in the history of humanity." It is now over twenty years since Hittel wrote. Those living at present in California can say how far the ideas of the writer have been realized, and what great changes have been made within that time. These early Argonauts are passing rapidly away; one by one they are being gathered to the dark valley and shadow of death, but they are leaving behind them a monument which it is hoped will endure, through all time—the Empire of the Pacific.

SYNOPTICAL TABLES.

BAROMETRICAL PRESSURE.

Table showing the mean, highest, and lowest monthly barometer; also, the monthly range. Barometer not corrected for elevation or temperature.

1882.	Mean Monthly Barometer.	Highest Observed Barometer for the Month.	Lowest Observed Barometer for the Month.	Range for the Month.
January	30.06	30.28	29.74	.54
February	30.08	30.34	29.71	.63
March	30.03	30.30	29.65	.65
April	30.02	30.18	29.75	.43
May	29.92	30.13	29.77	.36
June	29.88	30.03	29.78	.25
July	29.92	30.09	29.80	.29
August	29.89	30.04	29.76	.28
September	29.90	30.08	29.74	.22
October	29.96	30.20	29.76	.44
November	30.02	30.31	29.76	.55
December	30.08	30.30	29.70	.60
Means	29.98	30.19	29.74	.43

BAROMETRICAL RECAPITULATION.

Mean barometer for the year	29.98
Maximum barometer for the year, February 20th, 9 P. M.	30.34
Minimum barometer for the year, March 13th, 2 P. M.	29.65
Highest monthly range for the year	.65
Lowest monthly range for the year	.22
Yearly range	.69

TEMPERATURE.

Table showing the Mean Temperature of the Months, Warmest and Coldest Days; also, the Maximum and Minimum Temperatures, the Greatest and Least Daily Variation, Monthly and Mean Daily Range.

1882.	Mean Temperature of the Month.	Mean Temperature of Warmest Days.	Mean Temperature of Coldest Days.	Maximum Temperature.	Minimum Temperature.	Greatest Daily Variation.	Least Daily Variation.	Monthly Range of Temperature.	Mean Daily Range of Temperature.
January	46.43	55.23	41.33	58.	31.	21.	3.	27.	12.77
February	45.83	54.66	37.66	60.	30.	21.	3.	32.	13.35
March	52.00	69.33	46.	76.	34.	31.	3.	42.	13.32
April	52.61	62.	47.33	79.	39.	31.	2.	40.	14.36
May	57.77	65.66	51.66	79.	44.	24.	5.	35.	14.35
June	59.23	62.66	56.33	70.	51.	14.	5.	19.	10.33
July	60.60	66.66	56.33	79.	53.	23.	6.	26.	12.09
August	60.36	64.66	57.33	75.	51.	19.	6.	24.	11.42
September	60.70	68.33	57.	84.	51.	30.	5.	33.	14.23
October	57.60	62.66	51.	76.	42.	27.	1.	34.	12.22
November	51.02	58.33	45.73	65.	35.	27.	3.	30.	12.3
December	49.71	54.66	35.	64.	32.	22.	6.	32.	13.12
Means	54.49	62.03	48.14	72.08	41.08	24.16	4.	31.16	12.80

RECAPITULATION OF TEMPERATURE.

Mean temperature of the year....54.49
Mean temperature of the warmest day, March 20th....69.33
Mean temperature of the coldest day, December 31st....35.
Maximum temperature for the year, September 21st, 2 P. M....84.
Minimum temperature for the year, February 19th, 7 A. M....30.
Greatest daily variation, March 21st....31.
Least daily variation, October 13th.... 1.
Greatest monthly range, March....42.
Least monthly range, June....19.
Average daily range for the year....12.80
Average monthly range for the year....31.16
Yearly range of temperature....54.

SEASONS.

Mean temperature of Winter....46.80
Mean temperature of Spring....54.12
Mean temperature of Summer....60.06
Mean temperature of Autumn....56.44
Difference between the coldest and warmest of Spring months.... 5.77
Difference between the coldest and warmest of Summer months.... 1.13
Difference between the coldest and warmest of Autumn months.... 9.68
Difference between the coldest and warmest of Winter months.... 2.33
Difference between the coldest and warmest months of the year....14.87

RELATIVE HUMIDITY.

Table Showing the Relative Humidity, Precipitation, Weather and direction from which the Wind blew, from January 1st, 1882, to December 31st, 1882, inclusive.

1882.	Mean Relative Humidity.	Rainfall in Inches.	No. of Clear and Fair Days.	No. Cloudy Days.	No. Days in which Rain Fell.	No. Foggy Mornings.	No. of Mornings Overcast.	No. Mornings Frost.	Wind—1095 Observations. S. W. & W.	N. W. & N.	N. E. & E.	S. E. & S.	Calms.
January	77.42	2.42	20	11	9	1	2	10	16	22	10	12	33
February	77.68	2.05	18	10	10	..	1	10	21	13	5	19	26
March	76.03	4.20	21	10	11	..	2	4	16	19	9	18	31
April	79.46	1 51	20	10	8	..	5	4	33	17	2	11	27
May	82.60	.15	26	5	3	..	5	1	45	11	1	8	28
June	85.90	....	24	6	2	1	9	..	46	8	1	14	21
July	84.83	.....	29	2	2	..	21	..	45	10	1	8	29
August	84.66	.....	25	6	....	..	17	..	30	15	...	15	33
September	83.26	.42	27	3	2	3	9	..	34	9	1	8	38
October	86.37	2.65	24	7	9	2	1	1	34	7	4	11	37
November	84.48	4.33	20	10	7	4	4	9	14	6	10	8	52
December	88.23	1.14	22	9	9	4	1	11	11	13	9	11	49
Means and sums	82.57	18.87	276	89	72	15	77	50	345	150	53	143	404

RECAPITULATION OF RELATIVE HUMIDITY FOR THE YEAR 1882.

Mean relative humidity for the year.................................. 82.57
Highest relative humidity during the year..............................100
Lowest relative humidity during the year, March 25th, 2 P. M........... 28.6
Greatest variation of humidity in 24 hours, March 25th................ 65.7
Least variation of humidity in 24 hours, June 11th.................... .4
Rainfall in inches during the year.................................... 18.87
Rainfall in inches during the agricultural year—1881-82............... 18.03
Rainfall in inches since July 1, 1882 (Bay Nursery)................... 10.03
Number of clear and fair days..276
Number of cloudy days... 89
Number of days in which rain fell..................................... 72
Number of foggy mornings.. 15
Number of mornings overcast... 77
Nunber of mornings that frost was seen................................ 50
Wind, direction from south-west and west...............................345
Wind, direction from north-west and north..............................150
Wind, direction from north-east and east.............................. 53
Wind, direction from south-east and south..............................143
Calms..404

The following will more particularly illustrate the climate of Oakland for the seven past years, as it regards the equability of seasons and the difference between the warmest and coldest.

Seven Years.	Spring.	Summer.	Autumn.	Winter.	Difference.
1876..............	54.46	60.40	57.75	48.20	12.20
1877..............	55.18	61.17	57.67	50.39	10.78
1878..............	55.73	59.36	56.92	50.12	9.24
1879..............	56.16	60.07	56.73	49.57	10.50
1880..............	52.97	58.95	55.86	45.38	13.57
1881..............	56.35	60.27	54.78	51.10	9.17
1882..............	54.12	60.06	56.44	46.80	13.26
Means	54.99	60.04	56.59	48.79	11.25

Difference between the warmest and coldest means of the seasons for seven years is 11.25.

Monthly Rainfall as taken in Oakland by Mr. James Hutchison, of the Bay Nursery, for the consecutive Years mentioned.

MONTHS.	1873.	1874.	1875.	1876.		1877.		1878.		1879.		1880.		1881.		1882.	
	Quantity....	Quantity....	Quantity....	Quantity....	Days.........	Quantity....	Days.........	Quantity....	Days.........	Quantity....	Days.........	Quantity....	Days.........	Quantity....	Days.........	Quantity....	Days.........
July......................	......	......	......	.10	2	.18	2	......	2	......	2	......	...	......	...	......	2
August...........	......	......	......	......	1	......	...	......	3	......	2	......	...	......	...	......	...
September	......	......	......	.15	5	......	...	.57	3	......	2	......	...	.40	1	.42	2
October..........	.60	2.34	.30	4.74	10	.45	4	1.85	2	.70	5	.05	1	.82	7	2.65	9
November	.60	9.18	7.83	.25	2	1.62	8	.65	3	2.98	9	.35	2	1.49	5	4.33	7
December..	10.18	.31	4.10	......	...	1.75	8	.31	6	5.06	14	12.57	18	5.09	10	1.14	9
	1874.	1875.	1876.	1877.		1878.		1879.		1880.		1881.		1882.		1883.	
January..................	5.60	6.15	5.28	4.19	9	10.82	16	3.84	11	1.71	7	10.48	11	2.42	9	1.95	3
February................	1.80	.30	4.87	1.42	5	11.63	17	5.65	9	2.19	9	3.95	14	2.05	10	.70	5
March	5.25	1.65	4.55	.96	7	4.30	16	7.96	15	1.70	9	.88	3	4.20	11	3.33	8
April...............	1.25	....	.93	.22	5	1.18	6	1.17	12	8.46	18	1.40	8	1.51	8	2.20	8
May................	.75	.10	.45	.33	5	.40	2	1.39	7	1.04	5	.50	6	.15	3	3.50	11
June	......	1.64	.24	......	5	......	...	.16	1	......	...	1.16	2	......	2	......	...
Amount...........	26.03	21.67	28.53	12.33	51	32.33	79	23.55	74	23.84	82	31.24	65	18.13	66	20.22	61

The rainfall in California is rather phenomenal, and depending greatly upon latitude and topography. The average difference of annual rainfall in the State, extending from north-west to south-east, is a little over two inches for every degree, being thirty-four inches at Crescent City, and ten inches at San Diego. It is said to increase about one inch for every hundred feet in elevation in ascending the Sierra Nevada.

TABLE

Showing the Comparative Annual Meteorology of 1876, 1877, 1878, 1879, 1880, 1881 and 1882.

	1876.	1877.	1878.	1879.	1880.	1881.	1882.
Mean temperature of the year	55.09	56.29	55.28	55.11	53.69	55.62	54.49
Mean temperature of warmest day	74.	76.	69.33	75.33	70.66	70.	69.33
Mean temperature of coldest day	36.	41.63	37.	33.66	41.	42.	35.
Maximum temperature for the year	97.	96.	84.	93.	89.	87.	84.
Minimum temperature for the year	30.	30.	27.	27.	29.	31.	30.
Greatest daily variation of temperature	33.	38.	33.	46.	36.	35.	31.
Least daily variation of temperature	2.	1.	2.	....	1.	1.	1.
Greatest monthly range of temperature	49.	47.	46.	46.	48.	40.	42.
Least monthly range of temperature	19.	25.	23.	30.	28.	21.	19.
Average daily range of temperature for year	14.94	14.61	13.65	12.96	14.10	13.40	12.80
Average monthly range of temperature for year	34.92	35.5	32.5	38.	34.91	32.	31.16
Yearly range of temperature	67.	66.	57.	66.	60.	56.	54.
Mean relative humidity for year	83.	83.11	84.71	85.29	83.70	83.25	82.57
Highest relative humidity for year	100.	100.	100.	100.	100.	100.	100.
Lowest relative humidity for year	40.	34.40	38.60	39.	27.	29.	28.6
Greatest variation humidity in 24 hours	49.09	51.20	45.06	58.	54.40	37.40	65.7
Least variation humidity in 24 hours	.06	.01	.02	.30	.20	.30	.4
Rainfall in inches during the year	21.56	11.09	31.71	28.91	28.07	26.07	18.87
Rainfall in inches in agricultural years from July 1, 1875, to July 1, 1882	28.53	12.33	32.32	23.55	23.84	31.24	18.03
Number clear and fair days during year	268	301	255	266	258	276	276
Number cloudy days during year	98	64	110	99	108	89	89
Number days in which rain fell	63	58	78	89	53	67	72
Number foggy mornings	23	8	17	19	27	28	15
Number mornings overcast	51	44	64	63	86	52	77
Number mornings that frost was seen	35	35	36	46	62	47	50
Wind, direction from SW and W	342	364	311	355	346	402	345
Wind, direction from NW and W	210	150	173	150	136	136	150
Wind, direction from NE and N	34	63	45	50	59	58	53
Wind, direction from SE and S	163	150	164	126	172	138	143
Calms	340	368	402	372	385	331	404
SEASONS.							
Mean temperature of Spring	54.46	55.18	55.73	56.15	52.97	56.35	54.12
Mean temperature of Summer	60.40	61.17	59.36	60.07	58.95	60.27	60.06
Mean temperature of Autumn	57.75	57.67	56.92	56.73	55.86	54.78	56.44
Mean temperature of Winter	48.20	50.39	50.12	47.60	45.38	51.10	46.80
Difference between the warmest and coldest months of Spring	4.40	1.49	3.68	.70	9.91	5.12	5.77
Difference between the warmest and coldest months of Summer	1.99	1.10	.35	1.26	1.88	1.55	1.13
Difference between the warmest and coldest months of Autumn	6.13	7.76	5.93	9.14	7.70	8.79	9.68
Difference between the warmest and coldest months of Winter	5.00	6.09	1.28	5.13	2.37	5.34	2.33
Difference between the warmest and coldest months of the year	16.20	12.25	13.06	15.68	15.78	12.38	14.77

FOR SEVEN YEARS.

Mean difference between the coldest and warmest months for seven years..15.79

Mean temperature for seven years..55.25

Mean barometer for seven years..29.95

Mean relative humidity for seven years..83.22

Mean annual rainfall in inches for seven years..22.72

MONTHLY METEOROLOGICAL SYNOPSIS OF CASUAL PHENOMENA.

January—As a whole was an unpleasant month from the great diversity of weather in its storms of rain and frosty mornings. The morning of the 15th was the coldest of the season. Ice formed on the surface of shallow pools of water; frost came into yards—exposed lawns—streets and sidewalks were white with hoar frost; everything out of doors looked decidedly wintry. The thermometer marked 30° Fahr., on the 21st, 7 A. M.—lowest of the month. The 24th was showery through the day; at 4 A. M. a vivid flash of lightning occurred, followed by loud thunder that rolled away in the distance, followed by a fearful dash of rain and hail.

February—Like January was unpleasant from frost, rain and cloudy weather. The last four days of the month were rather marked by frequent solar and lunar halos. Parhelia were seen several times, quite beautiful in appearance.

March—Pleasant and warm, with frequent showers. Vegetation grew rapidly. On the 15th at 8 A. M., a hard shower attended with lightning and loud thunder, came up from the south with a high wind. The 26th was very warm; thermometer stood at 9 P. M., 74° Fahr.; the warmest ever observed in the evening for the time of year. The ocean wind came in late P. M. on the 27th for the first time in the season, cooling down the heated atmosphere produced from the several previous warm days.

April—Weather similar to that of preceding month. A beautiful rainbow was seen just before sunset on the 8th, and a bright Aurora Borealis was visible on the evening of the 16th from 8 to 11 o'clock, P. M., over a large portion of the northern horizon. The light appearing and disappearing at varying times, was of all shades and beauty. The color came and went in sudden flashes of lam-

bent flame, developing one after another all the colors of the prism. Streamers flashed and jetted far up towards the zenith, then dying away settled down into white corruscations, with darting, shooting scintillations, exhibiting a fine pyrotechnic display. This was the first Aurora Borealis seen in Oakland for many years, or on this coast. A majority of the people who witnessed it saw it for the first time in their lives. It was seen over the whole middle and northern portions of the State. In places the color was so red that many supposed an immense conflagration was taking place in the distance.

May—An unpleasant month; 12th, 13th and 14th were cool, with gales of wind and dust, which culminated on the morning of the 15th with a frost.

June—Cooler than the average for the month. Overcasts and westerly winds very prevalent. At $5\frac{1}{2}$ A. M. on the morning of the 27th, two shocks of an earthquake in quick succession were felt, which jarred buildings and swayed pendent objects. The vibrations were from N. E. to S. W. A very distinct rumbling sound accompanied the shocks.

July—More than usually pleasant, although overcasts with westerly winds were more than the average. Two light shocks of earthqnake occurred on the 15th at 7.45 P. M. Vibratory motion from east to west. In some houses, loose articles of furniture rattled and chandeliers were swayed by the motion. A light rain and mist occurred on the 31st, but the amount of rainfall was not appreciable to measurement.

August—No unusual phenomena during the month. At 8.45 P. M. on the 8th, a slight shock of earthquake was felt, with some noise. Vibration from S. E. to N. W.

September—A pleasant month. The new comet discovered by astronomers was seen for the first time, on the 22d, just before the morning twilight, in a southeasterly direction, in advance of the sun. The first rain of the season came on the 30th.

October—Various extremes of all kinds of weather prevailed, from the genial heat of summer to that of frost. On the 20th, at 8 A. M., a phenomenon of an earthquake occurred, consisting of what might be denominated two jogs and a half, without any vibration or undulatory movement. The cometary display in September was grand,

far greater than any celestial visitor for many a year, and continued its brilliant appearance throughout the month.

November—Was definitely marked, as regards weather, and more than an average in low temperature—rain, cold and frosts. The comet on the 5th shone out brightly. The tail seemed as luminous and long as ever, although it evidently had passed its perihelion and was slowly moving away. On the evening of the 18th an Aurora Borealis was seen by some, said to have been quite brilliant. Have doubts of it; think it a lingering twilight or zodiacal light.

December—Was a month of meteorological phenomena. The most marked was the transit of the planet Venus, which occurred on the 6th. The first view was at 8 o'clock, A. M., a mere spot on the red surface of the sun, apparently the size of a silver dollar, and traversing the lower southwestern limb or portion in something of an arc. The means used in observing the phenomenon were a piece of well smoked glass and an ordinary opera glass, which answered a good purpose, as the sequel showed, when the results of the observations were made known through the papers on the following day of those taken in the city of San Francisco, at Professor Davidson's astronomical observatory by J. J. Gilbert and others. The San Francisco *Chronicle* said:

"The wind yesterday was from the north, with a clear atmosphere, and all auspicious for an unclouded view and scientific study of Venus. The time of the several contacts was as follows, according to Washington time: First contact, 8.55 A. M.; first internal contact, 9.16 A. M.; second internal contact, 2.38 P. M.; last contact, 3 P. M., making the total time of the transit six hours and five minutes. The difference in time between Washington and San Francisco is about three hours and seventeen minutes. The first contact means when the edge of the sun is first touched by the nearer rim of Venus, and the first internal contact is when the outer edge of the sun's disk coincides with the outer edge of Venus. These two contacts are included in what is technically termed the planet's ingress, and accordingly were not witnessed in California. The second internal contact means when the first edge of Venus just touches the outer edge of the sun, and the last contact is described as the time when the inner edge of Venus and the outer edge of the sun coincide. The two last men-

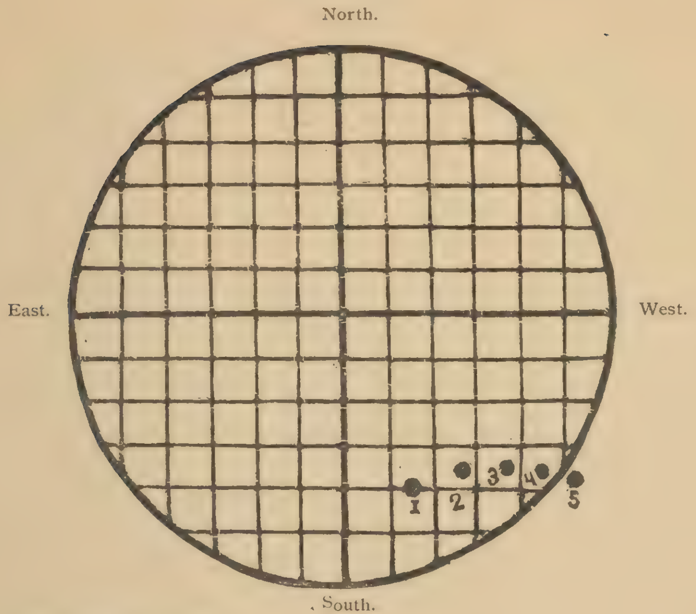
tioned contacts are comprised in the egress, and, therefore, were observed in San Francisco.

"At 11.25, mean time, which is about twenty seconds slower than the exact local time, a bright, golden appearance was noted upon the limb of the sun and the following limb of Venus, and ten minutes later the limb of each was very steady and colorless.

"The second internal contact, that is, the first of the two last contacts visible in the egress, or the outer union of Venus and the sun, occurred at 11.42. There was not any discoloration to speak of noticed; the cusps were very steady; the haziness in the atmosphere around Venus was well marked, and three minutes later a dim, narrow shaded white line, the atmosphere of Venus, was seen in the outer space. At 11.54 the images were not clear, but three seconds after both Venus and the sun were pronounced to be very steady. The last contact, when the inner edge of Venus and the outer edge of the sun touched, was recorded at 12.02. There was no bead-like appearance of Venus, and with a very clear break she passed away, to be seen no more in solar transit by the mortals of the present generation. At one stage of her transit variegated colors of yellow, purple and gold were exhibited upon the inner and outer rims of Venus. In passing off the sun's limb, from the inner to the outer contact, she was just twenty minutes.

"The following are the dates of the occurrence of the next six transits by Venus: June 8, 2004; June 6, 2012; December 11, 2117; December 18, 2125; June 11, 2247; June 9, 2255."

The following diagram represents the surface of the sun, cut into twelve segments in its greatest diameters, east and west, north and south. The location of Venus on the surface of the sun when first seen was, in local time, 8 o'clock A. M., and marked by figure 1, as near as could be located without the aid of astronomical instruments.



1—8 o'clock, A. M.
2—9 o'clock, A. M.
3—10 o'clock, A. M.
4—Internal contact, 11.45 o'clock, A. M.
5—External contact, 12.01 o'clock, P. M.

The time of transit by Washington time in all of its contacts:

1st external contact	8.55 A. M.
1st internal contact	9.16 A. M.
	21′ time.
2d internal contact	2.38 P. M.
2d external contact	3.00 P. M.
	22′ time.

Time of transit, from ingress to egress, was six hours and five minutes.

As seen in San Francisco, local time:

2d internal contact	11.42 A. M.
2d external contact	12.02 P. M.
	20′ time.

As seen in Oakland, local time:

2d internal contact	11.45 A. M.
2d external contact	12.01 P. M.
	16′ time.

What is the most remarkable in the above is the comparative time of the contacts.

Lunar and solar halos were quite numerous. The last seen of the comet was on the morning of the 2d at 2 A. M., south and east of the zenith. The latter part of the month was more than unusually cold, which culminated in a severe snow storm on the 31st, the last day of the month. The day was very cold, cloudy; wind north-east, quite a strong breeze. Snow began to fall 12.30 o'clock P. M., and continued until 3.30 o'clock P. M., when the wind veered to the south-east and it changed to sleet and rain. The depth of snow packed on the ground was one and a half inches. Not within the memory of white men on this coast had such a storm been known in Oakland. Not a flake of snow has ever before been seen to fall to the ground in this city for the eight years that meteorological observations have been taken.

1883.

SYNOPTICAL TABLES.

BAROMETRICAL PRESSURE.

Table showing the mean, highest, and lowest monthly barometer; also, the monthly range. Barometer not corrected for elevation or temperature.

1883.	Mean Monthly Barometer.	Highest Observed Barometer for the Month.	Lowest Observed Barometer for the Month.	Range for the Month.
January	30.16	30.46	29.64	.82
February	30.02	30.57	29.61	.96
March	29.93	30.21	29.58	.63
April	30.00	30.33	29.66	.67
May	29.91	30.16	29.66	.50
June	29.91	30.15	29.72	.43
July	29.91	30.07	29.79	.28
August	29.93	30.07	29.79	.28
September	29.88	30.00	29.73	.27
October	29.94	30.17	29.60	.57
November	30.05	30.32	29.91	.41
December	30.07	30.34	29.61	.73
Means	29.98	30.23	29.69	.54

BAROMETRICAL RECAPITULATION.

Mean barometer for the year	29.98
Maximum barometer for the year, February 17th, 2 P. M.	30.57
Minimum barometer for the year, March 27th, 2 P. M	29.58
Highest monthly range for the year	.96
Lowest monthly range for the year	.27
Yearly range	.99

TEMPERATURE.

Table showing the Mean Temperature of the Months, Warmest and Coldest Days; also, the Maximum and Minimum Temperatures, the Greatest and Least Daily Variation, Monthly and Mean Daily Range.

1883.	Mean Temperature of the Month.	Mean Temperature of Warmest Days.	Mean Temperature of Coldest Days.	Maximum Temperature.	Minimum Temperature.	Greatest Daily Variation.	Least Daily Variation.	Monthly Range of Temperature.	Mean Daily Range of Temperature.
January	43.73	53.	32.33	60.	26.	22.	6.	34.	13.48
February	45.18	58.	33.	70.	25.	27.	4.	45.	15.64
March	52.48	60.	47.66	76.	43.	30.	1.	33.	9.45
April	52.48	56.33	47.33	68.	39.	22.	4.	29.	12.
May	57.08	74.66	50.	93.	43.	31.	4.	50.	11.54
June	62.99	84.66	57.	103.	54.	38.	9.	49.	13.43
July	60.30	70.	56.33	85.	53.	27.	4.	32.	9.77
August	60.21	69.	57.	85.	51.	27.	5.	34.	12.55
September	63.29	76.66	57.	93.	52.	28.	6.	41.	14.06
October	56.82	62.33	52.	77.	42.	27.	4.	35.	13.77
November	52.65	57.33	43.	72.	34.	28.	2.	38.	13.23
December	46.77	54.	39.33	60.	29.	27.	4.	31.	14.80
Means	54.66	64.66	47.66	86.83	40.91	27.83	4.41	37.58	12.81

RECAPITULATION OF TEMPERATURE.

Mean temperature of the year.......... 54.66
Mean temperature of the warmest day, June 6th.......... 84.66
Mean temperature of the coldest day, January 19th.......... 32.33
Maximum temperature for the year, June 6th, 1.30 P. M..........103.
Minimum temperature for the year, February 20th, 7 A. M.......... 25.
Greatest daily variation, June 6th.......... 38.
Least daily variation, March 26th.......... 1.
Greatest monthly range, May.......... 50.
Least monthly range, April.......... 19.
Average daily range for the year.......... 12.81
Average monthly range for the year.......... 37.58
Yearly range of temperature.......... 78.

SEASONS.

Mean temperature of Winter..........46.20
Mean temperature of Spring..........54.68
Mean temperature of Summer..........61.16
Mean temperature of Autumn..........54.25
Difference between the coldest and warmest of Spring months.......... 5.60
Difference between the coldest and warmest of Summer months.......... 2.78
Difference between the coldest and warmest of Autumn months..........10.64
Difference between the coldest and warmest of Winter months.......... 5.98
Difference between the coldest and warmest months of the year..........19.26

RELATIVE HUMIDITY.

Table Showing the Relative Humidity, Precipitation, Weather and direction from which the Wind blew, from January 1st, 1883, to December 31st, 1883, inclusive.

1883	Mean Relative Humidity.	Rainfall in Inches.	No. of Clear and Fair Days.	No. Cloudy Days.	No. Days in which Rain Fell.	No. Foggy Mornings.	No. of Mornings Overcast.	No. Mornings Frost.	Wind—1095 Observations. S. W. & W.	N. W. & N.	N. E. & E.	S. E. & S.	Calms.
January	84.19	1.95	29	2	3	3	....	19	15	17	4	7	50
February	79.23	.70	22	6	5	..	1	12	23	13	6	9	33
March	86.06	3.33	12	19	8	4	14	..	48	8	1	9	27
April	80.24	2.20	22	8	8	..	7	..	43	16	...	4	27
May	84.50	3.50	17	14	11	..	7	1	41	10	3	9	30
June	80.57	.....	26	4	....	..	16	..	54	5	1	6	24
July	85.91	.....	23	8	....	1	23	..	59	1	...	4	29
August	85.84	.....	20	11	....	..	22	..	48	6	...	4	35
September	83.29	1.00	26	4	2	3	9	..	24	11	2	12	41
October	83.54	1.03	24	7	7	..	5	2	37	9	2	9	36
November	85.24	.90	20	10	3	7	1	9	20	12	3	6	49
December	85.98	1.15	25	6	6	3	....	14	16	11	7	12	47
Means and sums	83.71	15.76	266	99	53	21	105	58	119	119	29	91	428

RECAPITULATION OF RELATIVE HUMIDITY FOR THE YEAR 1883

Mean relative humidity for the year 83.71
Highest relative humidity during the year 100
Lowest relative humidity during the year, June 6th, 2 P. M. 33.9
Greatest variation of humidity in 24 hours, November 26th 48.8
Least variation of humidity in 24 hours, March 13th 3
Rainfall in inches during the year 15.76
Rainfall in inches during the agricultural year—1882-83 .... 20.22
Rainfall in inches since July 1, 1883 (Bay Nursery) 4.08
Number of clear and fair days 266
Number of cloudy days 99
Number of days in which rain fell 53
Number of foggy mornings 21
Number of mornings overcast 105
Nunber of mornings that frost was seen 58
Wind, direction from south-west and west 438
Wind, direction from north-west and north 119
Wind, direction from north-east and east 29
Wind, direction from south-east and south 91
Calms 428

The following will more particularly illustrate the climate of Oakland for the eight past years, as it regards the equability of seasons and the difference between the warmest and coldest.

Eight Years.	Spring.	Summer.	Autumn.	Winter.	Difference.
1876..............	54.46	60.40	57.75	48.20	12.20
1877..............	55.18	61.17	57.67	50.39	10.78
1878..............	55.73	59.36	56.92	50.12	9.24
1879..............	56.16	60.07	56.73	49.57	10.50
1880..............	52.97	58.95	55.86	45.38	13.57
1881..............	56.35	60.27	54.78	51.10	9.17
1882..............	54.12	60.06	56.44	46.80	13.26
1883..............	54.63	61.16	54.25	46.20	19.26
Means	55.20	60.18	56.30	48.47	11.24

Difference between the warmest and coldest means of the seasons for eight years is 11.71.

Monthly Rainfall as taken in Oakland by Mr. James Hutchison, of the Bay Nursery, for the consecutive Years mentioned.

MONTHS	1873.	1874.	1875.	1876.		1877.		1878.		1879.		1880.		1881.		1882.		1883.	
	Quantity....	Quantity....	Quantity....	Quantity....	Days.........	Quantity....	Days.........	Quantity....	Days.........	Quantity....	Days.........	Quantity....	Days.........	Quantity....	Days.........	Quantity....	Days.........	Quantity....	Days.........
July	....	....	....	.10	2	.18	2	....	2	....	2	....	...	....	...	....	2	....	...
August......	....	....	....	....	1	....	...	....	3	....	2	....	...	....	...	....	...	....	...
September	....	....	....	.15	5	....	...	.57	2	....	2	....	...	.40	1	.42	2	1.00	2
October	.60	2.34	.30	4.74	10	.45	4	1.85	2	.70	5	.05	1	.82	7	2.65	9	1.03	7
November.	.60	9.18	7.83	.25	2	1.62	8	.65	3	2.98	9	.35	2	1.49	5	4.33	7	.90	3
December..	10.18	.31	4.10	....	...	1.75	8	.31	6	5.06	14	12.57	18	5.09	10	1.14	9	1.15	6
	1874.	1875.	1876.	1877.		1878.		1879.		1880.		1881.		1882.		1883.		1884.	
January	5.60	6.15	5.28	4.19	9	10.82	16	3.84	11	1.71	7	10.48	11	2.42	9	1.95	3	....	...
February ..	1.80	.30	4.87	1.42	5	11.63	17	5.65	9	2.19	9	3.95	14	2.05	10	.70	5	....	...
March	5.25	1.65	4.55	.96	7	1.30	16	7.96	15	1.70	9	.88	3	4.20	11	3.33	8	....	...
April.........	1.25	....	.93	.22	5	1.18	6	1.17	12	8.46	18	1.40	8	1.51	8	2.20	8	....	...
May....	.75	.10	.45	.33	5	.40	2	1.39	7	1.04	5	.50	6	.15	3	3.50	11	....	...
June.........	....	1.64	.24	....	5	....	...	.16	1	....	...	1.16	2	....	2	....	...	....	...
Amount	26.03	21.67	28.55	12.36	51	32.33	79	23.55	74	23.84	82	31.24	65	18.13	66	20.22	64	....	...

The rainfall in California is rather phenomenal, and depending greatly upon latitude and topography. The average difference of annual rainfall in the State, extending from north-west to south-east, is a little over two inches for every degree, being thirty-four inches at Crescent City, and ten inches at San Diego. It is said to increase about one inch for every hundred feet in elevation in ascending the Sierra Nevada.

TABLE

Showing the Comparative Annual Meteorology of 1876, 1877, 1878, 1879, 1880, 1881, 1882 and 1883.

	1876.	1877.	1878.	1879.	1880.	1881.	1882.	1883.
Mean temperature of the year.................	55.09	56.29	55.28	55.11	53.69	55.62	54.49	54.66
Mean temperature of warmest day..........	74.	76.	69.33	75.33	70.66	70.	69.33	84.66
Mean temperature of coldest day............	36.	41.63	37.	33.66	41.	42.	35.	32.33
Maximum temperature for the year.........	97.	96.	84.	93.	89.	87.	84.	103.
Minimum temperature for the year..........	30.	30.	27.	27.	29.	31.	30.	25.
Greatest daily variation of temperature...	33.	38.	33.	46.	36.	35.	31.	38.
Least daily variation of temperature.......	2.	1.	2.	....	1.	1.	1.	1.
Greatest monthly range of temperature ..	49.	47.	46.	46.	48.	40.	42.	50.
Least monthly range of temperature........	19.	25.	23.	30.	28.	21.	19.	29.
Average daily range temperature for year	14.94	14.61	13.65	12.96	14.10	13.40	12.80	12.81
Average monthly range of temperature for year..	34.92	35.5	32.5	38.	34.91	32.	31.16	37.58
Yearly range of temperature....................	67.	66.	57.	66.	60.	56.	54.	65.
Mean relative humidity for year	83.	83.11	84.71	85.29	83.70	83.25	82.57	83.71
Highest relative humidity for year	100.	100.	100.	100.	100.	100.	100.	100.
Lowest relative humidity for year............	40.	34.40	38.60	39.	27.	29.	28.7	33.9
Greatest variation humidity in 24 hours...	49.09	51.20	45.06	58.	54.40	37.40	65.7	48.8
Least variation humidity in 24 hours.......	.06	.01	.02	.30	.20	.30	.4	.3
Rainfall in inches during the year..	21.56	11.09	31.71	28.91	28.07	26.07	18.87	15.76
Rainfall in inches in agricultural years from July 1, 1876, to July 1, 1883	28.53	12.33	32.32	23.55	23.84	31.24	18.03	20.22
Number clear and fair days during year..	268	301	255	266	258	276	276	266
Number cloudy days during year............	98	64	110	99	108	89	89	99
Number days in which rain fell...............	63	58	78	89	53	67	72	53
Number foggy mornings..........	23	8	17	19	27	28	15	21
Number mornings overcast.....................	51	44	64	63	86	52	77	105
Number mornings that frost was s en......	35	35	36	46	62	47	50	58
Wind, direction from SW and W......	342	364	311	355	346	402	345	428
Wind, direction from NW and W............	210	150	173	150	136	136	150	119
Wind, direction from NE and N..............	34	63	45	50	59	58	53	29
Wind, direction from SE and S...............	163	150	164	126	172	138	143	91
Calms..............	340	368	402	372	385	331	404	438
SEASONS.								
Mean temperature of Spring	54.46	55.18	55.73	56.15	52.97	56.35	54.12	54.63
Mean temperature of Summer..................	60.40	61.17	59.36	60.07	58.95	60.27	60.06	61.16
Mean temperature of Autumn...........	57.75	57.67	56.92	56.73	55.86	54.78	56.44	54.25
Mean temperature of Winter.........	48.20	50.39	50.12	47.60	45.38	51.10	46.80	46.20
Difference between the warmest and coldest months of Spring......................	4.40	1.49	3.68	.70	9.91	5.12	5.77	5.60
Difference between the warmest and coldest months of Summer...................	1.99	1.10	.35	1.26	1.88	1.55	1.13	2.78
Difference between the warmest and coldest months of Autumn....................	6.13	7.76	5.93	9.14	7.70	8.79	9.68	10.64
Difference between the warmest and coldest months of Winter.....................	5.00	6.09	1.28	5.13	2.37	5.34	2.33	5.98
Difference between the warmest and coldest months of the year...................	16.20	12.25	13.06	15.68	15.78	12.38	14.77	19.26

FOR EIGHT YEARS.

Mean difference between the coldest and warmest months for eight years..19.26

Mean temperature for eight years.......... ....55.08

Mean barometer for eight years...................................29.95

Mean relative humidity for eight years............................83.67

Mean annual rainfall in inches for eight years.........................22.75

RAINFALL IN SAN FRANCISCO FROM 1849 TO 1877 INCLUSIVE.

	1849.		1850.		1851.		1852.		1853.		1854.		1855.	
	Quantity...	Days.......	Quantity...	Days.......	Quantity...	Days.......	Quantity...	Days.......	Quantity...	Days.......	Quantity...	Days.......	Quantity...	Days.......
July............	......	..	......	..	......	..	......	..	......	..	......	..	......	..
August..........	......	..	......	..	......	..	......	..	.04	1	.01	1	......	..
September.......	......	..	.33	..	1.03	1	......	..	.46	4	.15	3	......	..
October.........	3.14	3	......	..	.21	2	.80	1	.12	2	2.41	9	......	..
November	8.66	8	.92	7	2.12	5	5.31	12	2.28	12	.34	2	.67	7
December........	6.20	12	1.05	4	7.10	14	13.20	20	2.32	21	.81	3	5.76	15
	1850.		1851.		1852.*		1852.		1854.		1855.		1856.	
January.........	8.34	15	.72	5	.58	4	3.92	11	3.88	10	3.67	11	9.40	13
February........	1.77	5	.54	4	.14	4	1.42	5	8.04	16	4.77	10	.50	4
March...........	4.53	7	1.94	9	6.68	14	4.86	6	8.51	11	4.64	12	1.60	5
April...........	.46	3	1.23	8	.26	3	5.37	9	3.12	9	5.00	10	2.94	6
May.............	......	..	.67	3	.32	1	.38	7	.02	1	1.88	6	.76	3
June............	......	..	......	..	......	..	......	..	.08	2	......	..	.03	1
	33.10	53	7.40	44	18.14	48	35.26	70	23.87	79	23.56	67	21.66	54

	1856.		1857.		1858.		1859.		1860.		1861.		1862.	
	Quantity...	Days.......	Quantity...	Days.......	Quantity...	Days.......	Quantity...	Days.......	Quantity...	Days.......	Quantity...	Days.......	Quantity...	Days.......
July............	.02	1	......	..	.05	2	......	..	.21	1	......	..	......	..
August..........	......	..	.05	2	.16	2	.02	1	......	..	......	..	......	..
September.......	.07	2	......	..	......	..	.03	1	......	..	.02	1	......	..
October.........	.45	5	.93	3	2.74	4	.05	1	.19	12	......	..	.40	2
November........	2.79	9	3.01	11	.69	5	7.28	15	.58	3	4.10	12	.15	3
December........	3.75	12	4.14	8	6.14	14	1.57	6	6.16	21	9.54	16	2.35	9
	1857.		1858.		1859.		1860.		1861.		1862.		1863.	
January.........	2.45	7	4.36	8	1.28	4	1.64	8	2.47	8	24.36	18	3.63	9
February	8.59	15	1.83	8	6.32	18	1.60	7	3.72	8	7.53	10	3.19	10
March...........	1.62	6	5.55	8	3.02	11	3.99	13	4.08	8	2.20	11	2.06	8
April...........	......	..	1.55	4	.27	4	3.14	8	.51	4	.73	9	1.04	9
May.............	.02	3	.34	3	1.55	4	2.86	11	1.00	3	.74	5	.26	2
June............	.12	1	.05	1	......	..	.09	2	.08	2	.05	1	......	..
	19.82	61	21.71	56	22.22	68	22.27	73	19.00	70	49.27	83	13.08	52

RAINFALL IN SAN FRANCISCO—Continued.

	1863.		1864.		1865.		1866.		1867.		1868.		1869.	
	Quantity...	Days......	Quantity...	Days......	Quantity...	Days......	Quantity...	Days......	Quantity...	Days......	Quantity...	Days......	Quantity...	Days......
July...........	.....	..	.....	..	.....	..	.....	..	.....	..	.....	..	.....	..
August.........	.....	..	.21	3	.....	..	.....	..	.....	..	.....	..	.....	..
September......	.03	1	.01	1	.24	2	.11	1	.04	1	.....	..	.12	1
October........	.....	..	.13	3	.26	4	.....	..	.20	1	.15	3	1.29	2
November.......	2.55	5	6.68	8	4.19	10	3.35	11	3.41	6	1.18	5	1.19	5
December.......	1.80	8	8.91	18	.58	8	15.16	18	10.69	18	4.34	11	4.31	7
	1864.		1865.		1866.		1867.		1868.		1869.		1870.	
January........	1.83	5	5.14	9	10.88	16	5.16	15	9.50	17	6.35	14	3.89	9
February.......	....	..	1.34	8	2.12	9	7.20	9	6.13	9	3.90	5	4.78	9
March..........	1.52	9	.74	4	3.04	12	1.58	9	6.30	12	3.14	12	2.00	8
April..........	1.57	4	.94	3	.12	1	2.36	8	2.31	9	2.19	5	1.53	4
May............	.78	5	.63	2	1.46	6	.....	..	.03	2	.08	2	.20	3
June...........	.....	..	.....	..	.04	1	.....	..	.23	3	.02	1	.....	..
	10.08	37	24.73	59	22.93	69	34.92	71	38.84	78	21.35	58	19.31	47

	1870.		1871.		1872.		1873.		1874.		1875.		1876.	
	Quantity...	Days......	Quantity...	Days......	Quantity...	Days......	Quantity...	Days......	Quantity...	Days......	Quantity...	Days......	Quantity...	Days......
July...........	.....	..	.....	..	.....	..	.03	4	.....	..	.....	..	.01	1
August.........	.....	..	.....	..	.....	..	.15	3	.....	..	.....	..	.02	2
September......	.03	1	.03	2	.14	1	.....	..	.83	2	.....	..	.26	3
October........	.....	..	.11	2	.21	1	.68	2	2.73	8	.22	2	.69	7
November.......	.43	4	3.72	9	2.62	3	1.31	6	5.92	7	6.73	15	.23	3
December.......	3.38	8	16.74	14	7.25	10	10.12	20	.28	4	3.08	10	.....	..
	1871.		1872.		1873.		1874.		1875.		1876.		1877.	
January........	3.07	7	4.22	10	2.17	8	4.85	14	6.97	11	6.41	14	4.36	9
February.......	3.76	10	6.97	20	4.24	17	1.83	10	.20	1	3.96	7	1.14	7
March..........	1.29	8	1.64	10	.78	4	3.55	15	1.08	6	4.37	11	.91	7
April..........	1.93	5	1.10	7	.52	3	1.04	7	.02	1	1.04	8	.25	6
May............	.21	3	.16	3	.01	1	.34	4	.11	2	.18	1	.....	..
June...........	.....	..	.02	2	.08	1	.08	2	1.01	3	.02	1	.....	..
	14.10	46	34.71	79	18.02	49	24.98	85	19.35	45	25.63	69	9.87	45

MONTHLY METEOROLOGICAL SYNOPSIS.

January—The month, as a whole, was decidedly unpleasant, cold and winter-like. The snow that fell on the 31st of preceding month had nearly all melted off before the morning of the 1st, with exception of that on the foothills, which lasted through the day. Barometer stood 30.46, 10 oclock, A. M, on the 8th. 11.45 o'clock P. M., on the 23d, a severe shock of earthquake was felt, attended with a noise, and wave-like motion from southeast to northwest. Frost was seen on nineteen mornings, and for several days did not disappear during the day in shaded localities.

February—Like the preceding month was cold and disagreeable. Frost was seen on fourteen mornings. On the 6th, a storm began at 6 A. M., of rain, sleet and snow, which fell in some places so as to cover the ground, or make it look white. Foot-hills white with snow. Barometer on the 17th, 2 P. M., 30.57. The last few days of the month weather warmed up with a decided change in the atmospherical temperature.

March—Very pleasant. The last part of the month was rainy and warm. Two slight shocks of earthquake on the 30th. One, 7.42 A. M., with two vibrations, from northwest to southeast, in quick succession. One at 7.50 A. M., a light shock.

April—A pleasant month, very favorable to agricultural pursuits, rain and warm weather in the right time.

May—Was unprecedented in the amount of rainfall, 3.50 inches. Not within the period of observations had so great an amount fallen in May. It had a tendency to keep back the ocean summer winds until the last few days of the month, when the season set in for the dry time.

June—with the exception of the great atmospherical heat of the 5th and 6th, was the average in weather for the month. The morning of the fifth was clear and very warm. The thermometer at 6 A. M., 78°; 7 A. M., 81°; 8 A. M., 87°; 12.15 P. M., 97°; 2 P. M., 94°; 5 P. M., 91°; 9 P. M., 76°—a very warm night. On the morning of the 6th the sun rose in the northeast, warm and burning-hot. Tender plants and leaves were scorched and burned so dry they could readily be reduced to powder by rubbing between the fingers. At 10 oclock, A. M., a high wind commenced blowing from the N. N. E., which blew almost a gale until 2 P. M., when it veered

round to the N. and N. W. A current of humid atmosphere from the surface of the ocean was poured into the excessively heated air, which in a few hours reduced the high temperature to temperate heat.

The following shows the temperature of each hour through the hot portions of the day, and the relative humidity or atmospherical saturation:

Hour.	Thermometer.	Humidity.
5 o'clock, A. M.	82 degrees.	45.5
6 " "	86 "	38.7
7 " "	89 "	37.3
8 " "	91 "	36.3
10 " "	97 "	35.
11 " "	100 "	32.1
12 " M	100 "	39.2
1 " P. M.	102 "	35.6
$1\frac{1}{2}$ " "	103 "	33.9
2 " "	99 "	36.2
3 " "	95 "	52.7
4 " "	93 "	54.8
5 " "	81 "	59.
6 " "	71 "	75.4
7 " "	68 "	79.3
8 " "	66 "	83.8
9 " "	65 "	84.3

July and August—Weather about the average for the corresponding months of other years. Dry and cool.

September—Light sprinkle of rain on the 2d and 21st. On the 29th quite a heavy rainfall took place during the afternoon. The streets were well washed, and water ran freely in the gutters; the first rain appreciable to measurement of the season. Month quite pleasant.

October—An earthquake occurred on the 10th, at 1 oclock, A. M. The rumbling noise that attended the shock was very loud and prolonged, sounding like a heavy fire engine going over a street crossing and passing onward over the pavement. Wave, or vibration, from W. N. W. towards E. S. E. Chandeliers moved back and forth, and windows rattled in their frames. At 8.45 and 9.10 o'clock, P. M., two light shocks were observed. Oscillation from east to west. Light rains fell several times during the month, but not of sufficient amount to benefit agricultural pursuits to any extent.

November—Was cold moderately frosty and dry. A high barometer, with a deep atmospherical current, was almost constantly observed. Rain fell several times in light showers. The great meteorological phenomenon was the luminous sunsets and sunrisings. On the 25th, previous to the sun's rising, at the early approach of dawn, when twilight first made its appearance, a white, luminous color, of crescent shape, preceded the rising of the sun, gradually fading into a darker hue beneath the arch down to the line of the horizon. As daylight approached, this crescent of white light was gradually pushed up towards the zenith, changing in color to a reddish pink, with a pale green hue beneath. The arch or crescent had an apparent diameter of 60 degrees, and changed its hues to various colors as it vanished before the light of the sun. A hoar frost was on the ground in exposed situations; wind northwest, blowing a fresh breeze. A cool but pleasant day followed. As sunset approached, the western horizon began to glow with rose and pink tints, changing into red and lurid colors, extending high towards the zenith. No cloud was to be seen, no cause was visible for this lurid hue. The reflection upon all objects was that of a large conflagration in the distance. The sunset on the following day, the 26th, was still more grand in the display of color. A few long, dark, watery, stratified clouds in the west, lay motionless, like dark spots, on the evening sky, and, amidst the changing colors from every other direction, added to the interest of the scene which was taking place. At one time the whole visible horizon was a pale olive green, excepting the portion where the sun had set, which was a bright crimson changing into a deep, lurid red. These colors were so bright and luminous as to be reflected from all objects and surfaces on which the light fell, giving to everything a peculiar and weird shadow. Long after sunset, when the ordinary twilight should have disappeared, the gorgeous display of changing colors held high carnival in mid air. This phenomena continued more or less each morning and evening throughout the balance of the month, the cause of which is not known or satisfactorily answered.

December—The meteorological phenomena was marked by a deep N. W. current, high barometer, low temperature, frosty mornings, luminous twilights, occasional light rains, ground very dry, agricultural prospects gloomy. Many fear a dry season, as the rainfall has been less for the season than usual, but not unprecedented for Oakland. The last half of 1877 but 4 inches of rain fell, in 1878 3.38 inches, and in 1883 4.08 inches.

MODIFYING CAUSES OF THE CLIMATE

ON THE

PACIFIC COAST OF THE UNITED STATES AND BRITISH COLUMBIA.

It is said that every country in the world, to a greater or less extent, has a climate peculiar to itself. In many respects it may be similar to that of another, but not identical, for the various factors that go to make it are not always equally alike, or bring the same influences to bear on each individual region of the earth. It was once thought that climate depended mostly on latitude and the declination of the sun either north or south of the equator; but more recent observations show that many other causes which are independent of these modify temperatures and precipitation.

The western coast of Europe and North America are examples of similar climate, modified by the same corresponding causes, ocean and air currents. Without entering into an extended inquiry over the various portions of the world in comparing climatic factors, which would be uninteresting to a majority of readers and embrace more than is designed to be written in this paper; therefore, the knowledge, positive and theoretical, of the climatic conditions that are imposed upon the western slope of the Pacific Coast, bordering on the ocean, from Alaska towards the south, and the causes as far as observed, is all that would interest the local or general reader. The same general causes that modify the climate of Alaska, British Columbia, Oregon and California, extending into Mexico, have long been known to meteorologists, and those who have made physical geography a study. But the many local modifying influences that these great currents of water and air meet with, as they impinge upon the northwestern coast of the continent, by high mountain ranges, inland valleys and solar heat, gives as various climates as the topography of the country is different where their influence is felt. The ocean current that modifies the climate of the Pacific Coast, is a portion of the great equatorial current which is deflected northerly and

easterly when it meets the eastern coast of Asia. This current, a portion of the warm equatorial current, as it flows toward the northwest, washing the eastern shores of China and Japan, takes the name of the Japan current, or Kuro-Siwo. At or near latitude 50° and longitude 170°, it divides; one portion, continuing northerly, passes through Behring straits, the other south of the Aleutian Islands assumes the name of the Aleutian current. It advances eastward until it strikes the northwest coast of North America; then, turning acutely to the southeast, flowing along the western shore, until what is left is drawn into the great equatorial current at or near the Tropic of Cancer, again to make the circuit of nearly a quarter of a hemisphere. Various elements of this great current, when taken into consideration, that go to make it one of the physical constants in the formation of climate, seems as yet but partially understood. Its depth, width, velocity and temperature have not been investigated as have some of the currents of the Atlantic Ocean. Professor Davidson, of San Francisco, seems to have been almost the only one who has given this subject any attention, with the exception of some casual observers, who have here and there made memoranda for their own curiosity. The professor starts with a maximum temperature of the Japan current of 88°, Fahrenheit. At Alaska, 50.06°. Six to eight hundred miles west from San Francisco, 60.33°; one hundred miles west, 55.05°. At the tidal station at Fort Point the mean temperature for eight years was 55.66°, that of the air being 54.97°. The mean temperature of the ocean nine hundred miles west of San Francisco for one year was 60.52°, as found by the ocean steamers going and coming from Yokohama to San Francisco. This shows a difference of temperature to be in the water of the ocean current one hundred miles to the west and that at the tidal station on shore to be .61° less; at six to eight hundred miles 4.67° greater; at nine hundred miles, 4.86° greater or warmer.

This great ocean current in flowing from its origin to the coast of California has parted with 32.34° of heat; or, in other words, has lost, from the average temperature of the equatorial waters (78°), 22.34°, and leaves an average surface ocean temperature, to the distance of 900 miles west of California, of 57.89°. The temperature of the air along the coast, and the water, hardly ever raises more than two or three degrees, and the above figures show only 2.92° for the average difference in temperature of the water and air over a large

area of the ocean contiguous to the Pacific coast, and gives an explanation of the low temperature at the base of the atmospherical column that rests on the ocean's water. Also the great freedom from rain during the summer months, when the westerly winds overcast and fogs prevail.

For the purpose designed by this paper, the above is all the information that can be obtained bearing upon the temperature of the ocean's water in the vicinity of this Coast, with the exception of the counter or eddying current, said to have been discovered by Professor Davidson; who in describing the great stream that flows across the ocean, remarks that "a branch of this current continues direct to the Alexandrian Archipelago, and, striking the southern part of the coast, is deflected to the northward and westward," and calls it the warm Alaska current, which causes the high isothermal lines that exist directly on the Alaskan coast.

The great aerial air current that moves with the ocean stream, is the counter trade wind of the northern hemisphere, and seems to determine the character of the climate, almost wholly, of California. As it strikes this coast it is always the high current, and flowing from a westerly direction changing but very little the point of the compass at the same date of time in each year.

It oscillates from the south of west at one portion of the year to the north of west at another, moving from north to south with the declination of the sun, and then back again. During the summer season it blows nearly from the west, and in the winter, being acted on by the polar winds, is given a more northwesterly direction.

Physical geography has so well described the great systems of atmospherical currents that it is superfluous to enter into a description of all the winds, and the laws that produce them. Owing to solar heat, and the diurnal motion of the earth, three distinct belts or systems of winds are produced. Easterly winds in the tropical zone, westerly winds in the temperate zone and northerly or northwesterly in the higher latitudes. These zones of wind move bodily to and fro with the vertical rays of the sun, toward the north in summer, and toward the south in the winter. On the movement of these zones of water and air, rests the causes of the wet and dry seasons over the great area of country bordering on the western coast of the United States.

The most philosophical and scientific dissertation, perhaps, on

this subject for depth of research, long and patient labor, appertaining to the wind currents, climate of California and contiguous territory, was made by the late lamented B. B. Redding, and read before the Academy of Sciences in San Francisco, in January, 1878. His observations are as follows:

"As California is within the northern temperate zone, it is primarily to the movement as a body north or south of this belt of wind that we are indebted for our dry summers and winter rains. Where, within the tropics the northeastern and southeastern trade winds meet, is a region of calms and rains. This belt of calms and rains, as has been stated, moves northward and southward with the sun's declination. Where, within the temperate zone, the northern and northwesterly winds from the polar regions meet the westerly return trade winds, is a region of storms and rains. These belts also follow the sun's declination north and south. Applying these laws to this coast; at our midsummer, the vertical sun would be on the Tropic of Cancer, and in that vicinity the northeasterly and southeasterly trade winds would meet, create ascending air, consequently calms; this air, laden with moisture, would rise into cooler regions, when a portion of its moisture would be precipitated, making tropical rains; this air would flow north and south towards the poles. Confining our view to that portion which would flow toward the north pole, the larger part of it must descend to the earth within thirty degrees of latitude, under the law, as stated by Professor Henry; as in going north it continuously has to pass over a portion of the earth which is moving less rapidly than the portion it has left, it is deflected and become a southwest wind. The greater portion of this upper current having descended to the earth within thirty degrees and returned to join the trade wind, the remainder would flow towards the pole, portions descending in its course at all points where the rarification of the air near the earth's surface would permit. These descending currents cause the local variable winds of our temperate zone, but the aggregate of all of them is the prevailing westerly return trade wind. The descending currents cannot give rain, as they only fall to the earth when they become colder than the air near the earth's surface. In falling they are constantly arriving at places of warmer temperature than those they have left; they, therefore change to a condition of taking up moisture, rather than of parting with it. *Where the great body of the descending return trade wind reaches the earth between latitudes twenty-eight degrees and thirty-five degrees*

must, therefore, on this coast, be comparatively a rainlessregion. Other lessening portions of the upper current would pass on until they met the prevailing northerly wind from the polar regions, when their temperature would be lowered and their moisture condensed and fall as rain. The conflict of this descending current with the polar wind would create storms and give rise to electrical phenomena. The prevailing northerly polar wind reaches to about latitude sixty degrees, varied by the declination of the sun.

"This view of the causes of the tropical, temperate and polar zones of prevailing winds, is in accordance with the theoretical deductions of Professor Ferrell concerning the course of atmospheric currents moving on a sphere, and appears to be confirmed by the belts of low barometer prevailing in the vicinities of the equator, and of latitude 60 degrees. The polar wind, being colder, is heavier than the return trade wind, and where they meet, the tendency is for this polar wind to become a surface wind, and prevent the upper current from reaching the earth until it has been reduced to the same temperature. The operation of these general laws can be more clearly seen on this coast than on that of the Atlantic and Gulf States. There, the northeast trade winds are forced into the great cauldron of the Gulf of Mexico. The Cordilleras of Central and South America and Mexico form a wall against their progress; they rise, turn to the north as an upper current, and return to the earth as southwest winds.

"The Rocky Mountains, one great chain of which extends from the center of the continent northwesterly to the Arctic Ocean, assist in the deflection. The great prairies extend in an unbroken line in the same direction from the mouth of the Mississippi, to the same frozen ocean at the mouth of the Mackenzie River, in about latitude sixty-two degrees. Professor J. W. Foster, in his work on the "Physical Geography of the Mississippi Valley," states that the sources of the Mississippi River are but 1,600 feet above the ocean. Professor Coffin has shown from the records in the Smithsonian Institute in his article on the "Winds of the Northern Hemisphere," that between latitudes sixty and sixty-six degrees there prevails a belt of easterly and northeasterly winds. These winds, coming from the Arctic ocean, meet the great chain of the Rocky Mountains, are deflected into northwest winds and pass unobstructed along this great stretch of prairie land into the States east of the Rocky Mountains. The conflict between

the northwest polar winds and the moisture-laden southwest winds from the Gulf of Mexico, gives all the Atlantic States north of Florida their summer rains. As far back as 1850, Professor Espy, in his second report on meteorology to the Secretary of the Navy, without, at that time, more than suspecting the cause, reported as the result of a long series of observations, that in the northern part of the Atlantic States the winds generally, in great storms, set in from north of east and terminate from north of west, and in the southern part of the Atlantic States they set in from south of east and terminate from south of west.

"It is doubtful if the Atlantic trade winds ever give rain to California. That portion which passes the mountains through the valley of the Rio Grande, precipitating its moisture on the White Mountains and Black Hills of Arizona, which, by the meteorological records of the Smithsonian Institute, are shown to have an annual average of twenty inches of rain.

"That these general laws may be applied to California as the cause of our climate, I will assume to follow a given portion of air along well known points on the coast. At midsummer, at noon, the sun would be vertical in Southern California just north of Cape St. Lucas. In this vicinity, this portion of air, having been a part of the trade wind, would have become heated and saturated with moisture. It would rise until it met colder regions, when it would part with some of its moisture; a portion would return to the earth within thirty degrees, again to join the trade winds, and another portion pass on towards the north as a part of the great upper current. Under the operation of Professor Henry's law, the greater part must return to the earth between latitude thirty degrees and, say, latitude thirty-five degrees; the remainder would flow on towards the pole until it met the prevailing northwesterly winds; at these points there would be fogs and summer rains. Whenever the polar wind forced its way south of this, it would condense the moisture of these descending return trade winds and give rain. This they would do until they had passed so far south that their temperature would be raised to that of the descending return trades, when, of course, no moisture could be precipitated. It is these polar winds, forcing themselves among the descending return trade winds, that give British Columbia, Washington Territory and Northern Oregon their summer showers. Should they force themselves further south, they, in their passage, have to pass into warmer latitudes; they

would also meet the heat of our great valleys and deserts, and and become as warm as our prevailing summer wind, and, therefore, could not give California summer rains.

"But, from midsummer, the sun is for six months moving south, taking with him the great belts of winds of the tropical, temperate and polar zones, until, at our midwinter, his rays are vertical just north of the northern part of Chile, in South America. These belts, moving south with the sun during six months, the region of conflict between the polar winds and the variable winds which in summer was over British Columbia, Washington Territory and Oregon, has now moved south over Oregon and the northern and middle part of California. The temperature of the earth's surface and the air in contact with it, have been lowered by the withdrawal of the sun's more direct rays, and the polar winds are permitted to reach further to the south without increasing their temperature. The region of calms and the southern limit of the variable winds have, of course, also moved south with the sun, beyond the Tropic of Cancer. At this season, in the Pacific, the trade wind is not usually found north of latitude thirteen degrees, when, in winter, the descending return trade wind, coming from the southwest, meets the coast south of Cape St. Lucas, it is forced by the Cordilleras and the configuration of the main coast into the Gulf of California, and is deflected into a course from the southeast, or, to be more exact, as shown by the records kept by Dr. Gibbons, into a course from the south-southeast. Without doubt, the southwest return trade wind which strikes the coast of Lower California in winter north of Cape St. Lucas, is deflected by the high mountains parallel to the shore, and also passes over our coast counties as a southeast wind. H. S. Warner, in a paper read before the American Association for the Advancement of Science at its Baltimore meeting in 1858, was the first to note the fact that the waters of the Gulf of California supply the moisture to the southeast wind that bears to us our rains. It may be objected that the Gulf of California has not sufficient area from whence could be delivered the great volume of southeast winds that, at times, during our winters, flow over this State. The Gulf is not the cause of this wind, but it is the channel through which it flows, and gives to it direction. When the sun is vertical on the coast of Bolivia, just north of Chile—at our midwinter—he has carried south with him the northeast trade winds, until, as has been stated, they do not prevail north of about latitude thirteen degrees. The region of calms,

where the great body of the upper current returns to the earth again to join the trade winds, is, at this season, between latitudes thirteen and eighteen degrees. North of this region of calms, at this time, those portions of the upper current which pass further north, descend to the earth, under Professor Henry's law, as southwest winds. At latitude twenty degrees, the west coast of Mexico projects a bold headland into the Pacific Ocean, known as Cape Corrientes. South of the Cape the trend of the coast for nearly two thousand miles is east-southeast; north of this cape, the trend of the coast for more than one hundred miles, to Mazatlan, is north; from Mazatlan to the head of the Gulf of California, a further distance of six hundred miles, it is north-northwest. The Sonora arm of the Cordilleras rises above the table land of Mexico, at latitude twenty degrees, and runs north-northwest along the coast, nearly to the head of the Gulf of California. All of these southwest winds that strike the coast from Cape Corrientes north to Cape St. Lucas, are deflected by these mountains and forced up the Gulf as south-southeast winds. The United States Coast Survey have lately completed the survey of this gulf and parts of the Mexican coast north of Cape Corrientes. When their record of observations of the course of the prevailing winds in winter, the barometric pressure and the temperature of the air and water is published, I feel confident that it will be found that the southwest return trades prevail in winter north of Cape Corrientes, and are turned by the mountains and the coast up the Gulf of California, and so over this State as our southeast winds. It comes from this gulf warm and laden with moisture, and passes over the Colorado and Mojave deserts. These deserts, as shown by the meteorological records of the Smithsonian Institute, have a mean winter temperature of from forty-eight to fifty-six degrees. This is not sufficiently low to precipitate its moisture, and it passes on until it meets the Sierra Nevada and Coast Range. In ascending these it rises into cooler regions, finds a mean winter temperature of forty degrees and gives up some of its moisture. When it flows down into the southern end of the great valley of the Tulare, it meets a mean winter temperature of forty-eight degrees, which is higher than that of the mountains it has just passed. It therefore retains its moisture and passes on, until it meets a cold polar wind, and has another portion of its moisture condensed in a rain-storm, or, failing to meet this, passing still further north, until its moisture is condensed by the prevailing low temperature of a higher latitude. It is of frequent

occurrence in winter that a gentle southeast wind will blow for days, giving no rain south of the latitude of San Francisco, but cloudy weather at the northern end of the Sacramento valley, and light showers and rains from Red Bluff to Oregon. Therefore, the northern part of the State should receive more rain than the southern, and the mountains more than the valleys. The least rain should be in the hot deserts and on those sides of valleys most sheltered by mountains from the moisture bearing winds."

Meteorological observations, taken since the writing of the above fully confirm the assertion made respecting the rainfall, however phenomenal it may appear to be, and show, conclusively, that the precipitation in all the territory tributary to the influence of the above factors of climate, is subservient to meteorological laws, the same as in other parts of the world, differing only as the physical causes differ that produce the resultant effects. The average annual rainfall at Crescent City, in the extreme northern part of the State of California, is thirty-six inches, and diminishes about two inches for every degree of latitude towards the south, until, at San Diego, it is but ten inches. In altitude, it is found to increase about one inch for every one hundred feet in elevation in ascending the windward side of the Sierra Nevada range of mountains. Local causes have influences bearing upon the amount of rainfall in different localities, but they are nearly all topographical; and, when carefully studied, are easily explained, either for the small or great amount of average rainfall they receive.